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Full Length Research

Nature and Determinants of Rice Price Instability in Niger: Case of Gaya state Market

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This study analyzes the nature and determinants of rice price instability on the Gaya market. It aims to determine the factors influencing local rice prices to mitigate this instability and find appropriate solutions. The error correction model is used to analyze the influence of international rice prices on local rice prices. The data used are from the Agricultural Market Information System (SIMA). The base consists of a monthly panel of fifteen (15) years from 2006 to 2020. The results show that a 1% increase in the international price of rice increases the local price of rice by 0.904% in the short term and by 0.996% long term. In addition, an increase in rainfall of 1% reduces the local price of rice by 0.050% in the short term. The results from this analysis show that the international price positively influences the local price of rice. To this end, we suggest that the government: Increase the productivity of local producers to meet local demand to reduce the instability of imported prices, subsidize inputs to make local production competitive to constrain rice imports, encourage producers used short-term improved rice seed varieties to overcome the problem of irregular rainfall and increase the areas of hydro-agricultural facilities.

Keywords: Rice, Gaya, MCE, Local price, international price.

INTRODUCTION

Price is an adjustment variable between supply and demand for goods and services. This balance can be unstable due to the variability that act on the markets. This instability varies according to the conditions and geographic location of the markets (Minot, 2010). According to International Alliance of Catholic Development Agencies (CIDSE), (2011), Market fundamentals are often singled out as the primary cause of rising prices. Because demand is greater than supply and causes an increase in the price of goods on the market. This rise was passed on to African markets and led to social unrest in some countries, particularly in Africa south of the Sahara, with clashes that were sometimes deadly and threats of strike action (Grimoux et al., 2010). On the international market, the price of wheat has increased by more than 40% and that of rice by more than 60% (FAO, 2008). On the domestic market,

many factors, both exogenous and endogenous, can modify the supply and demand of food.

The market for agricultural products is the one with the most unstable price. The latter is often due to climate change, changes in the balance between supply and demand at national and global level and new strategies for accessing resources (Farm, 2009). The strong fluctuation of prices has negative consequences on the life of economic agents, whether consumer or producer. For example, during the lean period, prices increase and have a negative effect on consumer welfare, and during periods of overproduction, the price drops and affects producers' income. The latter, in this situation, will be unable to repay the loans contracted for production (Farm, 2009). Economic theories on price instability differ according to different sources of this instability. Some call it endogenous and others exogenous. More specifically Boussard (2013) asserts that price instability is the result of the behavior of market players. According to Galtier (2012) and Nahoua (2012) there are three (3) types of instability namely: natural instability, imported instability and endogenous instability. Natural instability comprises two types of phenomena which are: the seasonality of production and the variability of production. As for imported instability, it is the result of cross-border exchanges. Finally, endogenous instability has its origin in the functioning of the market. In addition, Collage and Taillet (1988) highlighted three other sources of instability. These are demand, exchange rate and supply.

Since the food crisis of 2007-2008, several economists have been interested in researching the determinants of cereal product price instability. Indeed, Temple et al., (2009) using the VECM and VAR concluded that in the long term, the price of imported rice is the only one that is sensitive to fluctuations in the international price with an adjustment period of about 4 months. As for Minkoua et al., (2010) affirm that the prices of fresh agricultural products are more unstable than those of storable products except for cassava derivatives at the Douala market. In addition, Nahoua (2012), in a study carried out in Côte d'Ivoire, shows that the volatility of international prices explains 51% of the price volatility of imported rice on the Adjamé market. According to FAO (2009) agricultural prices have remained low for several years, which not encourage producers to invest more in agriculture. This assertion confirms the principle of the rationality of the economic agent. He is a *homoeconomicus*, he knows what he wants and invests with the sole objective of having profit.

The agricultural sector in Niger is suffering greatly from climate change, this drastically reduces agricultural yield (Lobell et al., 2011), given that more than 90% of the population lives in rural areas (NIS, 2016), it inevitably leads to the famine which becomes a recurring scourge. But the question is, will climate change be the factors of price instability in Niger?

All these studies lead us to ask the following research question: What are the determining factors of the instability of rice prices on the markets of Niger?

The interest of this research is to analyze the price movements of rice on the markets of Niger. It is based on a selection of variables constituting the elements of the controversy on the instability of the prices of food products such as: the international price, the precipitation, the temperature, the quantity supplied and the cost of transport. It also makes it possible to determine the sources of rice price instability. Specifically, these are:

- Determine the factors influencing the fluctuation of the price of local rice.
- Measure the influence of the international rice price on the local rice price.

At the end of these specific objectives, we pose the following research hypotheses which will be verified following the study.

- Apart from the international price, there are other factors influencing the price of local rice.
- The variability of the price of rice on the international market is at the origin of the instability of the price of rice on the local market.

METHODOLOGY

The methodological approach used in this article is inspired by the work of Ambagna (2012). First, we perform a standard cointegration test to verify the existence of a long-term relationship between the international price of rice, rainfall, and the price of domestic rice. We then examine the overall behavior of the series by testing the hypothesis of a cointegrating relationship between the variables using the standard procedures of Johansen (1988). In a second step, after having verified and concluded the long-term relationship between the variables, we present an error correction model in its general form:

$$p_t^v = \beta_0 + \beta_1 * p_t^i + \beta_2 * x_t + \varepsilon_t \quad (1)$$

p_t^v:price of rice on the Nigerian market
p_t^i:price of rice on the international market
x_t: rainfall
β_0:a constant
$\beta_1 et\, \beta_2$respectively measure the effects of the international price and rainfall on the price of domestic rice
ε_t:the residue. It captures the effect of hard-to-observe variables such as transaction costs, information, etc.

Stationarity test and decision criterion

Economic analysis using the error correction model is important to first test the stationarity of the series before testing the cointegration of the variables because the presence of a unit root in the data has very important consequences statistically. A time series is stationary if it is the realization of a stationary process; this implies that the series has no trend or seasonality. Stationarity can be tested by several tests such as the Dickey-Fuller (DF) test, Phillip-Perron (PP) test or the Augmented Dickey-Fuller (ADF) test.

For our study, we used the Augmented Dickey-Fuller test to test the stationarity of the series. This involves testing the null hypothesis of the presence of stationarity against the alternative hypothesis of the absence of stationarity:
If ADF<critical value, then the alternative hypothesis of absence of unit root is not rejected. We conclude non-stationarity.
If ADF>critical value, then the alternative hypothesis is rejected, and the presence of stationarity is concluded.

Cointegration tests and error correction model

The cointegration test considers the order of integration of the series. The test of Engle and Granger, (1987) is used only if the series are integrated of order 1 and the test of Johansen, (1988) used when the series are integrated of different levels. The cointegration test consists in testing the existence or not of the long-term relationship between the variables.

In the case of this research, we will test the cointegration between three variables of the model such as the international price, rainfall, and the price of domestic rice:
When the non-cointegration hypothesis is rejected, the error correction model is estimated in the following form:

$$\Delta(Lp_t^v) = \beta_0 + \beta_1 * \Delta\left(Lp_t^i\right) + \beta_2 * \Delta(Lx_t) + \beta_3 dummy_t + \varepsilon_t \quad (2)$$

With $\beta_0$is the constant
$\beta_1, \beta_2 et \beta_3$are coefficients associated with the explanatory variables.
$dummy$ is the variable integrating the growing seasons which takes the value 1 for the harvest period and 0 for the lean season.

Presentation of the study area and analysis data

Study zone

Niger covers an area of 1,267,000 km2 and is populated by nearly 20 million inhabitants, 90% of whom are farmers (NIS, 2016).

However, we specifically focused on Gaya department due to data availability. This department is located at the southern strip of Niger. It borders Nigeria and Benin. The main activity of the inhabitants of this region is subsistence farming.

ANALYSIS DATA

The database used in this study is that of SIMA. It contains the national and international selling price variables for cereals from 2006 to 2020. The base consists of a panel with the monthly payment.

Data analysis and interpretation

Descriptive statistics

Table 1 indicates that the average rainfall in the department of Gaya is about 251 millimeters per year over the fifteen (15) years with an average national price of about 374 FCFA. Finally, this series shows that the average international price of rice over fifteen (15) years is 397 FCFA.

Econometric results

Error correction model

Most of the statistical properties of estimation methods apply to stationary variables, but that does not mean that non-stationary series are not estimable.

Non-stationary variables can be combined to obtain an error correction model. The only difference is that

Table 1. Descriptive statistics.

	Rainfall	National price	International price
Mean	250.83	373.47	396.52
Median	234.00	250.00	250.00
Maximum	422.00	750.00	800.00
Minimum	118.00	250.00	250.00
Standard deviation	98.93	164.54	185.44
Comments	180.00	180.00	180.00

Source: author from SIMA from 2006 to 2020

Table 2. Unit root test results.

Variables	ADF Statistics	Tabulated Statistics	Conclusion
Lnprix_nation	-12.00749***	1%: -2.57	I(0)
Lnprix_inter	-11.92912***	5%: -1.94	I(0)
D(lnrainfall)	-14.13168***	10%: -1.61	I(1)

Source: author based on Dickey-Fuller stationarity tests
***= significant at 1%

the non-stationary terms are interpreted as elements of a long-term equilibrium. This means that stationarity must be tested.

After checking the stationarity of the series and the cointegration between the variables, the following error correction model will be estimated by the OLS in a single step:

$$L(p_t^v) = \beta_0 + \beta_1 L(p_t^i) + \beta_2 D(L(x_t)) + \beta_3 L(p_{t-1}^v) + \beta_4 L(p_{t-1}^i) + \beta_5 dummy + \varepsilon_t \quad (3)$$

Series stationarity test

The unit root test carried out on the series of three variables of the model revealed that the price of domestic rice and the price of rice on the international market are integrated at level (I(0)) and that the rainfall variable is integrated at the first difference (I(1)). Finally, all the variables are integrated at the 1% threshold.

Cointegration test

The cointegration test allows us to determine the long-term relationship between the variables. Thus, as the three series of variables are not all integrated of the same order, to determine the long-term relationship between them we use Johansen's test. It is based on the critical values at the thresholds of 5% and 1% that we accept or reject H0. Indeed, if the Likelihood Ratio (LR) statistic is greater than the critical values given at the threshold of 5% and 1%, we reject H0: absence of cointegrating relationships between the series and we accept H1: presence of at least one cointegrating relationship between the series and it is assumed that there is at least one cointegrating relationship between the series studied. In this research case, as the results of the Table 2 show, the rank of cointegration is 3, so we accept the hypothesis of cointegration between the variables. So, all the variables are cointegrated at the 1% level. This allows us to estimate the error correction model.

Estimation of the error correction model

To estimate the error-correction model, we used Hendry's one-step method. The choice of this method is because the other two-step method which is also the most widely used is only applicable when there is a single cointegration relationship, whereas in this case we are in the presence of three cointegrating relationships. The estimation of the MCE gives short-

Table 3. Johansen's cointegration test.

H0	H1	η-Trace	Critical value	η-Max at 5%	Critical value at 5%
r=0	r>0	162.5352***	69.81889	66.49972	33.87687
r=1	r>1	96.03549***	47.85613	43.22385	27.58434
r=2	r>2	52.81163***	29.79707	38.46811	21.13162

Source: author based on Johansen's cointegration tests with Eviews
***= significant at 1%

Table 4. Results of the estimation of the error correction model.

Variable	Coefficient	Standard deviation	t-Statistic	Probability
Constant	0.491***	0.060	8,182	0.000
Lnprix_inter	0.904***	0.006	158,197	0.000
D(inrainfall)	-0.050**	0.023	-2.174	0.011
Lnprice_nation(-1)	-0.931***	0.075	-12.413	0.000
Lnprice_inter(-1)	0.927***	0.068	13,632	0.000
Dummy_season	0.004	0.006	0.667	0.506
Dependent variable =	Lnprix_nation			
Adjusted R-squared	0.993			
Log-likelihood	366.005			
F-statistic	5142.149***			
Prob(F-statistic)	0.000			
Durbin-Watson stat	2,024			

Source: Our estimates from Eviews software
***, ** indicate significance respectively at the 1% and 5% thresholds.

term and long-term elasticities of the variables of the model, allowing through the results of the Table 3 to conclude on a causal link between the explained variable and the explanatory variables. The restoring force is negative and significantly different from zero. The error correction model is therefore validated. The R 2 also shows 99% that the variability of the variable is explained by the explanatory variables. Fisher's global significance test shows that the model is globally significant at 1%.

RESULTS AND DISCUSSION

The estimation of the error correction model presents two relationships, namely: short-term and long-term between the estimated variables.

The results in Table 4 show that the coefficient β_3 associated with the restoring force is negative (-0.931) and significantly different from zero at the 1% threshold. Thus, shocks to rice prices on the Gaya market are corrected after 1 month 3 days (1/0.931=1.074).

The results show that in the short term the international price of rice has a positive coefficient (0.904) and significant at the 1% level. This means that if the international price of rice increases by 1%, then the price of rice on the Gaya market in the short term increases by 0.904 %. This can be explained by several reasons, including the increase in the cost of transport following the increase in the price of fuel often observed in Niger. When fixing the price of rice on the Gaya market, retailers consider the cost of transport to have a profit. The effect of the rise in the international price of rice on the price of local rice may also be due to the cost of production, which is expensive, i.e., labor and inputs, and to the depreciation of the FCFA per against the US dollar. The effect of currency depreciation on the price of local rice manifests itself in both the short and long

term.

As for precipitation, it has a negative and significant coefficient at the 5% threshold. This means that rainfall negatively influences the price of local rice in the Gaya market. So, if rainfall increases by 1%, the price of domestic rice in the short and long term decreases by 0.050 %. A good rainy season increases production and market supply. This results in a decrease in the price of local rice on the Gaya market. The effect of rainfall on the price of local rice is almost insignificant because the demand for rice is always greater than the supply. Also, the cultivated area is insufficient considering the demand for rice on the market.

As the single-stage model does not bring out the long-term elasticities, these long-term elasticities are calculated using the following formula:

$-\frac{\widehat{\beta_i}}{\widehat{\beta_3}}$ with i = 4.

The long-term elasticity of the local rice price with respect to the international price of rice is:

$$-\frac{\widehat{\beta_4}}{\hat{\beta}_3} = -\left(\frac{0{,}927}{-0{,}931}\right) = 0{,}996$$

For long-term relationships, the results of the relationship between the coefficients of the variables and the restoring force show that in the long term the variable of interest, which is the international price of rice, has an overall positive and significant coefficient at the 1% level. This implies that in the long term if the international price of rice increases by 1%, then the price of local rice increases by 0.996%. This is caused by the depreciation of the FCFA against the US dollar which increases the price of imported products.

When imported rice is expensive on the local market, this increase is also transmitted to the price of rice produced in Gaya, firstly because imports are decreasing while demand is not decreasing. Then the supply of local rice is insufficient while the demand is high. Finally, when the international price of rice increases, retailers adopt speculative behavior because they know that imports will decrease, and local supply is insufficient.

The results of the research confirm the hypotheses posed above. Following the first hypothesis which was to assume that there would be other factors that influence the price of local rice, the results show that rainfall significantly influences the price of local rice in the short term and in the long term.

As for the second hypothesis which consisted in assuming that the variability of the international price of rice influences the variability of the price of local rice on the Gaya market, the results show that the variability of the international price of rice really influences the variability of the price of rice. local in the short and long term.

CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

This study shows that the instability of rice prices on the market of Gaya is caused by an instability of the international price of rice and the irregularity of rainfall within this region. The results show that a 1% increase in the international price of rice increases the local price of rice by 0.904% in the short term and by 0.996% in the long term. This confirms the research hypothesis which stipulates that the instability of the local price of rice is due to instability of the international price of rice. The fact that the local demand for rice is rigid and that, on the other hand, the local supply is very insufficient to cover the national demand, means that the price of imported rice influences the price of local rice.

In addition, rainfall is a key factor in rice production. In this study, 1% increases in rainfall decreases the local price of rice by 0.050% in the short term. If it heavily rains rice production increases. This increase in the quantity produced increases the rice supply on the Gaya market, following the law of supply and demand, the local price of rice decreases. However, rainfall is a major factor in rice production.

The limitations of this study are the lack of certain variables that can influence the price of local rice and that the data at our disposal are only from the department of Gaya. Therefore, a possible study in the same field can take these limitations into account to improve the research.

Following all the above, the study comes out with the following recommendations:

- Increase the productivity of local producers to meet local demand to reduce the instability of imported prices,
- Subsidize inputs to make local production competitive to constrain rice imports,
- Constrain imports by customs tariffs to encourage the population to consume the local product but while making it accessible to all,
- Pushing the producers used varieties of improved short-lived rice seeds to overcome the problem of irregular rains,
- Promote off-season rice cultivation by drilling boreholes in productive localities,

- Increase the areas of hydro-agricultural developments.

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